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CROTALUS TIGRIS AND CROTALUS ENYO, TWO LITTLE KNOWN RATTLESNAKES OF THE SOUTHWEST

BY

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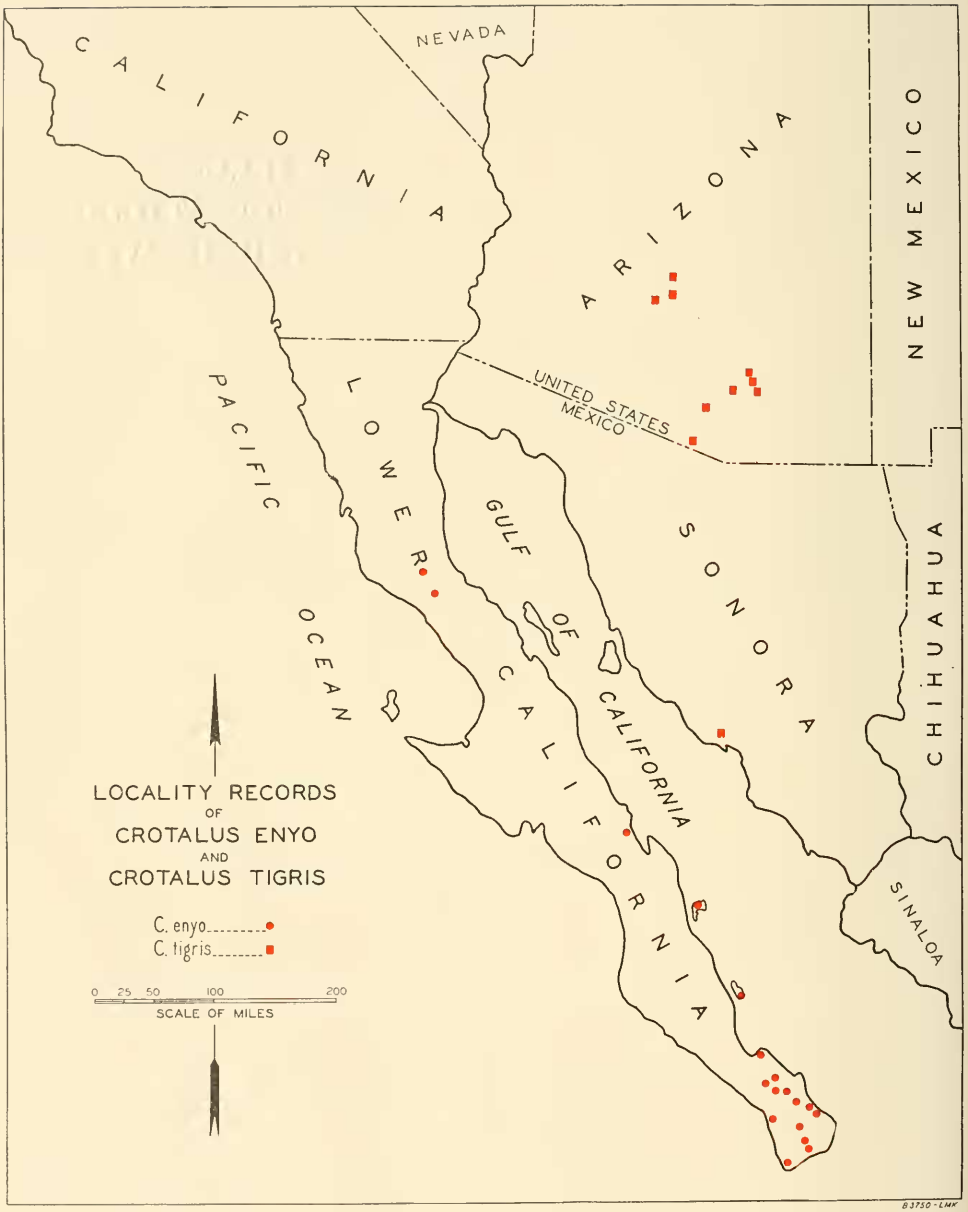
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CROTALUS TIGRIS AND CROTALUS ENYO, TWO LITTLE KNOWN RATTLESNAKES OF THE SOUTHWEST

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INTRODUCTION

Within the past two years I have been fortunate in procuring a number of specimens of *Crotalus enyo* and *Crotalus tigris,* some alive and some preserved, and have had the opportunity of comparing them with species with which they are sometimes confused. Specimens extending the previously known ranges have been available. As neither species has been plentifully represented in collections, it will be useful to record the data accumulated. These are based on an examination of 25 specimens of *tigris* and 30 of *enyo.* Eight of the latter and about twenty-five of the former have been seen alive.

When referring to *tigris* I am excluding the form found in eastern California and southern Nevada, which I consider a subspecies of *Crotalus confluentus* (intermediate between *C. c. lutosus* and *C. c. mitchellii*), and which I have described as *C. c. stephensi.*[1] *Tigris* as it occurs in southern Arizona and northern Mexico is, I think, a distinctive snake, probably more closely allied to *enyo* than to *stephensi.* At any rate all present evidence indicates a valid species, quite separate from *mitchellii* or *stephensi.*

Similarly *enyo,* although lately considered a subspecies of *confluentus* by do Amaral,[2] should, I believe, on the evidence here presented, be continued in a specific status.

Seen alive, both *tigris* and *enyo* exhibit rather striking characteristics, especially when one's impressions of typical rattlesnakes are based on the predominant southwestern forms, that is, *C. confluentus, C. atrox* and their subspecies and allies. For, compared with these, both *tigris* and *enyo* have proportionately smaller heads, slender necks and in the case of *tigris,*

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[1] KLAUBER, 1930, p. 106.

[2] DO AMARAL, 1929-b, p. 93.

larger rattles. The head size of *tigris* is disproportionate in both dimensions, while the *enyo* head is slender but not especially short.

I do not think either species is particularly rare within its habitat; their scarcity in collections and zoological gardens is rather because of the inaccessibility of their ranges. *Tigris* is to be found in the scattered mountain groups of south-central Arizona and Sonora, while *enyo* is restricted to Lower California and certain Gulf of California islands.

Since most descriptions of *Crotalus tigris* have been based on composite *tigris-stephensi* material, and as new *enyo* material is available, it is deemed desirable to present complete redescriptions of the species, followed by a discussion of their differential characteristics as compared with certain other forms.

Crotalus tigris Kennicott

Tiger Rattlesnake

Plate 23, fig. 1.

1859. *Crotalus tigris* Kennicott, Report U. S. Mexican Boundary Survey, Vol. 2, p. 14 (Type locality: Sierra Verde and Pozo Verde).

1861. *Caudisona tigris* Cope, in Researches upon the Venom of the Rattlesnake, (Mitchell), p. 122.

1929. *Crotalus tigris tigris* Amaral, Bull. Antivenin Inst. of America, Vol. 2, No. 4, p. 84.

Lepidosis and Form.—Size medium among rattlesnakes. Scale rows at midbody usually 23 (64 per cent), occasionally 22, 24 or 25, average 23.3. Scale rows are dropped in the following order: From 23 the fifth or sixth to 21, and then the fourth or fifth to 19. As is usual amongst the rattlesnakes the order of dropping rows is difficult to determine with accuracy. The scales are keeled, except the first two rows on the sides. Ventrals: males, max. 172, min. 161, av. 166 (16 specimens); females, max. 173, min. 165, av. 168 (4 specimens). Anal entire. Caudals: males 23 to 26, average of 16 specimens 24.7; females 20 in all of 4 specimens. The males usually have from 24 or 25 caudals. The caudals, while generally entire, may be divided at either end of the series.

The supralabials number 11 to 15, being usually 14 (44 per cent), 13 (24 per cent), or 12 (20 per cent), rarely 11 or 15. The infralabials number 11 to 16, being usually 14 (49 per cent), 13 (29 per cent), or 15 (16 per cent).

The rostral is wider than high, and is in contact with the prenasals. The prenasals are normally in contact with the supralabials, but such contact is partially prevented on one side of one of the specimens examined, by the extension, to the rostral, of the small scales anterior to the pit. The internasals (scales in contact with the rostral between nasals, regardless of size or relative position) are 2 in number. The scales on the crown, anterior to the supraoculars, vary from

11 to 25 and average 15.6. The minimum scale rows between supraoculars vary from 3 to 6, averaging 4.8.

Supraocular sutures or indentations are normally absent in this species, there having come to my attention a single specimen with sutures, and in this it is not certain whether these are true sutures or merely folds resulting from the state of preservation. The nasals are 2–2. The loreals are normally 1–1, only 11 per cent of the specimens having 2. The scales along the canthus rostralis, from rostral to supraocular, number from 3 to 5, averaging 3.5; the posterior is generally the largest of the series.

There are usually two preoculars, but occasionally a third is formed by cutting off an upper corner of the normally superior preocular. The upper preocular, which is the larger, is usually not in contact with the postnasal. In 76 per cent such contact is prevented by the contact of the post-canthal with the loreal, in 11 per cent by the presence of a small upper loreal.

The minimum scale rows from labials to orbit number 1 or 2, averaging 1.6. Generally the fifth supralabial is the largest; usually the third and fourth are in contact with the pit borders.

The first infralabials are usually undivided (6.8 per cent divided). Normally 3 or 4 infralabials are in contact with the genials on each side.

The mental is triangular. The genials are in a single pair, relatively short and obtuse. Intergenials are not present.

In shape the head is usually sub-elliptical. The average ratio of body length to head length in 22 adults (over 580 mm. in length) is 26.1, max. 28.8, min. 23.9. This high ratio is one of the most distinctive characteristics of the species. The ratio of head length to head width averages 1.38. The ratio of the distance across the supraoculars to the space between averages 2.6 (range 3.4[3] to 2.3) in 18 specimens.

The ratio of the length of tail to total body length exclusive of rattle varies from .077 to .092 in the males (average .081) and .065 to .069 in the females (average .067).

The largest specimen examined measured 778 mm. (31 in.) in length. Specimens 665 mm. and 616 mm. in length contained eggs.

The rattles are conspicuously large for the body size.

Pattern and Color.—The first impression of *tigris* is of a ringed or banded snake, more so than any other rattler, but with dull and poorly defined rings, and with both pattern and ground color consisting largely of punctations.

The head markings are obscure and indefinite; there are a few irregular blotches on the head posteriorly. The side marks are less definite than in most rattlesnakes. An obsolescent dark ocular stripe is usually present. Rarely this is bordered above by a postocular light stripe two scales wide and passing backward on the second or third row above the commissure. Supraocular cross dashes are sometimes present, but are rarely conspicuous or even; when present they usually curve inward and forward. The labials are heavily spotted, but otherwise the underside of the head is clear.

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[3] One specimen only reaches this figure; the next highest is 2.8.

The body pattern consists of a series of cross-bands numbering from 40 to 51 and averaging about 44. These are not complete on the ventral surface. The bands are of indefinite outline and heavily marked with, and in fact consist largely of, dark dots. They are wider along the center of the back than on the sides and are usually more definitely outlined on the posterior half of the body. Dorsally, the blotches are wider than the interspaces. A secondary series of small blotches between the major rings is usually in evidence on the first two or three rows of each side, especially toward the tail. Often scattered scales in the blotches have black tips, a characteristic of *stephensi* and some other species. Rarely a specimen will be found with definite hexagons anteriorly, which do not become complete bands until toward the posterior end of the body.

In color the blotches are usually dark gray or brown; it is difficult to give definite color values thereto as the surface is so speckled. The ground color between is usually gray, lavender or blue-gray, often with a pink or creamy tinge on the sides. The ground color is lighter toward the tail and thus is in greater contrast with the dark rings. The ventral surface is straw, yellow or pink, heavily mottled and punctated. Specimens from the Santa Catalina Mountains are pinker than those from other areas.

The tail is crossed with from 5 to 10 dark brown, speckled rings of irregular outline, not complete on the undersurface and with narrower interspaces. The last two or three are less clear. At this point the ground color is often yellow-brown.

The anterior rattle is usually brown or tan, never black.

Material.—The description contained herein is based on an examination of the following specimens:

AMNH 2537, Pima Canyon, Santa Catalina Mts., Pima Co., Ariz.

CAS 34274, Santa Catalina Mts., Pima Co., Ariz.

U. Kansas 5332-3, Ventana Canyon, Santa Catalina Mts., Pima Co., Ariz.

U. Kansas 6632, Sabino Canyon, Santa Catalina Mts., Pima Co., Ariz.

LMK 774, 787, Squaw Peak, near Phoenix, Maricopa Co., Ariz.

LMK 1584-5, Salt River Mts., S. of Phoenix, Maricopa Co., Ariz.

LMK 3131-2, 3206, 3212, 3239-43, Estrella Mts., Maricopa Co., Ariz.

LMK 3237, Caballo, near Guaymas, Sonora, Mex.

LMK 3238, Sabino Canyon, Santa Catalina Mts., Pima Co., Ariz.

Toledo Zoo 86-87, Estrella Mts., Maricopa Co., Ariz.

USNM 471-2, Sierra Verde and Pozo Verde, Arizona-Sonora Boundary. (Type and Paratype)

USNM 39012, Coyote Mts., Pima Co., Ariz.

Total preserved specimens 25. Of the above, 15 specimens were seen alive, together with about 10 others not in this list.

Localities, Range.—The verified localities where this species has been taken are the following, specimens having been examined from all except Amole Peak.

ARIZONA: Pima County
Santa Catalina Mts. (Pima, Ventana and Sabino Canyons)
Amole Peak, Tucson Mts.
Sierra Verde and Pozo Verde. (Type Locality)[4]
Coyote Mts.
Maricopa County
Squaw Peak. (N. of Phoenix)
Salt River Mts. (S. of Phoenix)
Estrella Mts. (SW. of Phoenix)
SONORA: Caballo, near Guaymas.

I find no other authentic localities in the literature. All California or Nevada records refer to *C. c. stephensi*, *C. c. mitchellii* or intergrades between these two. Do Amaral is, I think, incorrect in referring Woodbury's Utah *C. concolor* to this species.[5] USNM 5271 from Fort Buchanan, Ariz. is *C. c. confluentus* and USNM 32725 from Grand Canyon is *C. c. abyssus*. These localities, occasionally mentioned, should therefore be suppressed. Dunn has shown[6] that the specimen from Ventanas, Durango, Mex., referred to this species by Boulenger in his Catalogue, is *C. stejnegeri*.

Thus the known range may be described as the mountains of south-central Arizona and Sonora, from the vicinity of Phoenix to Guaymas. (See Map)

The range of *tigris* overlaps that of *mitchellii* in the vicinity of Phoenix, Arizona, both being found in the surrounding mountains. *Tigris* and *stephensi* (which two were once considered identical) do not contact by about 200 miles, and this intervening territory is occupied by *mitchellii*, with which *stephensi* intergrades. Thus *stephensi* and *tigris* could be related only through *mitchellii*, but I find no evidence of intergradation between the two latter.

Habits.—Little is known concerning the habits of the species. Its habitat seems to be restricted to the canyons and foothills of the desert mountains. The fact that it has not been taken in such well collected ranges as the Huachucas, the Chiricahuas, etc., would indicate that it is probably not present in all of the southern Arizona mountain groups.

From the specimens seen in captivity, and the presence of unusually long rattle strings, I should assume this to be a relatively even tempered and inoffensive snake.

Two specimens taken in October contain eggs.

F. E. Walker captured a specimen at 9 P. M. on a rainy night in August in Sabino Canyon, Santa Catalina Mts.

R. R. Humphrey told me of finding two specimens in Sabino Canyon at about 7 P. M., one in a bush about two feet above ground, the other under a rock shelf. Both rattled before they were seen.

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[4] This may be in Sonora. Modern maps show the Sierra Pozo Verde (Mts.) at the south end of the Baboquivari Mts. straddling the International Boundary Line. (Long. 111° 40′ W.)

[5] DO AMARAL, 1930, p. 115; see also Woodbury, 1930, p. 23.

[6] DUNN, 1919, p. 215; Boulenger, 1896, p. 580.

As might be expected, with snakes having such small heads, the fangs are short and delicate. The venom is small in quantity, yields of dried purified venom being as follows:

Lot 197, 1 large specimen, 0.0109 g.
Lot 265, 3 large specimens, 0.0366 g.
Lot 281, 7 large specimens, 0.08 g.

This gives an average yield for a fresh adult specimen of 0.0116 g.

Dr. T. S. Githens and Mr. I. D. George of the Antivenin Institute of America report the M. L. D. of this species (for 350 g. pigeons) to be 0.04 mg. which is relatively powerful amongst rattlesnake venoms, being three and one-half times *C. atrox* venom. However, because of the small yield and short fangs, this is not to be considered a particularly dangerous snake.

Red mites were found on one specimen and ticks on another.

Diagnostic Characters.—Pattern alone will nearly always distinguish *tigris* from all other *Crotalus* species except some of the *confluentus* forms. From the latter, with the exception of *C. c. mitchellii* and *C. c. stephensi,* it may be segregated by the number of internasals, which are 2 in *tigris* compared with a normal of 3 or more in all *confluentus* subspecies except these two; also the rostral is normally higher than wide in *confluentus* (except *stephensi* and *mitchellii*), while in *tigris* it is wider than high.

From *mitchellii* the tiger rattlesnake can usually be distinguished by the rostral-prenasal contact (which is normally imperfect or entirely prevented in the former), by the lower ventral scale count, simpler scale pattern on the head (as, for instance, an average of 16 scales before the supraoculars in *tigris* compared with over 30 in *mitchellii*) and finally by the proportionate head size.

Tigris may be segregated from *stephensi* by relative head size, ventral plates (which average 10 higher in the latter), and supraocular sutures, which are absent in *tigris* and nearly always present in *stephensi.* This latter is a key character which will usually render a determination simple in well preserved specimens.

From *enyo, tigris* differs in a number of ways, the pattern being most quickly evident, for not only are there blotches with clear outlines on the former and indefinite cross stripes or bands on the latter, but there is also a lower number of blotches on *enyo,* and the characteristic punctated application of color is less apparent in *enyo.* Other differences not so useful as key characters will be pointed out in a discussion of the differential characteristics.

Crotalus enyo (Cope)

Lower California Rattlesnake

Plate 23, fig. 2.

1861. *Caudisona enyo* Cope, Proc. Acad. Nat. Sci. Phila., 1861, p. 293 (Type locality: Cape St. [San] Lucas, Lower California.)

1865. *Crotalus enyo* Cope, Bull. U. S. Nat. Mus. No. 1, p. 33.

1883. *Crotalus oregonus* var. *enyo* Garman, Mem. Mus. Compar. Zool. Cambr., Vol. 8, No. 39, p. 174.

1896. *Crotalus tigris* (part) Boulenger, Cat. Snakes British Museum, Vol. 3, p. 580.

1929. *Crotalus confluentus enyo* Amaral, Bull. Antivenin Inst. America, Vol. 2, No. 4, p. 93.

Lepidosis and Form.—Size, moderate among rattlesnakes. Scale rows at midbody usually 25 (83 per cent), occasionally 27 (14 per cent), rarely 23 (3 per cent). The order of dropping rows is the sixth or seventh from 25 to 23, the fifth or sixth from 23 to 21, and the fourth or fifth from 21 to 19. The scales are very strongly keeled (more so than *tigris*), only the first row on each side being smooth. Ventrals: males, max. 167, min. 160, av. 164 (13 specimens); females, max. 177, min. 165, av. 170 (10 specimens). Anal entire. Caudals: males 22 to 28, average of 14 specimens 25.1; females 18 to 22, average of 10 specimens 19.3. The males usually have from 23 to 27, and the females from 18 to 20 caudals; while generally entire, there may be a few at either end of the series divided.

The supralabials average 13.4; they usually number 13 (45 per cent), or 14 (38 per cent), occasionally 12 (9 per cent), or 15 (8 per cent). The infralabials average 13.6; they generally number 14 (42 per cent), or 13 (36 per cent), occasionally 15 (14 per cent), or 12 (8 per cent).

The rostral is always wider than high, and is in contact with the prenasals. The prenasals are normally in contact with the supralabials, but such contact is partially or entirely prevented in 12½ per cent of the specimens examined, by the extension to the rostral of the small scales anterior to the pit. The internasals invariably number two. The scales on the crown anterior to the supraoculars vary from 13 to 25, the average being 16.5. The minimum scale rows between supraoculars vary from 2 to 6, averaging 4.2. Supraocular sutures are absent. The nasals are 2–2. About 86 per cent of the specimens have two loreals, the rest, one, three, or four; the lower is always the larger. There is an extra scale usually present below the first canthal, between the supraocular and the upper loreal, which might be considered a third loreal, but is not so classified herein. This extra scale is so prevalent as almost to constitute a key character. The scales along the canthus rostralis, from rostral to supraocular, usually number 3, sometimes 2 (17 per cent), or 4 (25 per cent).

The upper preocular, which is the larger, is usually (95 per cent) not in contact with the postnasal. In 7 per cent such contact is prevented by the contact of the post-canthal with the lower loreal, in 88 per cent by the presence of a small upper loreal. The upper preocular is rarely split to form a third preocular.

The minimum scale rows from labials to orbit usually number 2, rarely 3. Generally the fourth supralabial is the largest; usually the third and fourth are in contact with the pit borders.

The first infralabials are undivided. Normally 3 (rarely 2) infralabials are in contact with the genials on each side.

The mental is triangular. The genials are in a single pair, relatively short and obtuse. Intergenials are not present.

In shape the head is (for *Crotalus*) unusually narrow and not particularly distinct from the neck, thus resembling *polystictus* more than any other species. The average ratio of body length to head length in 14 adults (over 575 mm. in length) is 23.8, max. 25.8, min. 22.5. The ratio of head length to head width averages 1.52. The ratio of the distance across the supraoculars to the space between averages 3.5 (range 2.9 to 4.7) in 18 specimens. The 4.7 specimen is exceptional, the next highest being 4.0. The supraoculars are elevated at the outer edges to a greater extent than in any other rattler except *cerastes*. The minimum bridge between is, naturally, deep set and further back than in most species.

The ratio of the length of tail to total length, exclusive of rattle, varies from about .084 to .098 in the males (average .090) and from .061 to .072 in the females (average .065).

The largest specimen examined measured 854 mm. ($33\frac{1}{2}$ in.), the smallest 207 mm. ($8\frac{1}{8}$ in.).

Pattern and Color.—The first impression of *enyo* is of the clearly and definitely outlined dorsal blotches, and the beautiful harmony of the colors. It is, I think, the most strikingly marked of the rattlesnakes.

The head is fawn color. A pair of parallel, irregular dark brown marks begin at the supraoculars and extend to the middle of the head, at which point they are interrupted by outwardly divergent light marks. Following this break, the dark marks re-appear and continue to the neck, where they engage the first dorsal blotch.

A dark brown stripe two or three scales wide arises behind and below each eye and passes backward above the commissure. The usual light postocular line of the rattlesnakes is not emphasized in this species; it is merely a light area three to five scales wide between the two sets of dark marks. No definite preocular light line is present.

A light supraocular cross-mark is always present; it is clearly and cleanly outlined and curves forward and inward from the outer edge. Often the posterior ends of the supraoculars are touched with a light spot.

The labials are punctated with gray. The lower head surface may be spotted or clear.

The body patterns consists essentially of a set (30 to 42, average 33.5) of dorsal brown blotches on a fawn background. A secondary series of black spots appears on each side. The dorsal blotches are edged with black. In shape they are longitudinal sub-rectangles anteriorly; about 8 or 10 spots behind the head these change to hexagons, first with side points and then with extensions reaching toward the secondary series. Finally the two series coalesce about 10 blotches from the tail and thereafter the pattern becomes a series of rings, wider dorsally and with reduced sharpness of outline. Low down on the sides there is a tertiary series of spots, of smaller size than the secondary, and alternating therewith. The interblotch spaces are punctated with gray, except on the scale rows bordering the blotches, which thus appear lighter. The punctations increase posteriorly. The blotch outlines do not adhere to scale rows.

The tail rings, numbering 4 to 8, are neither complete nor definite. There is

little contrast with the ground color which, on the tail, is heavily punctated with gray.

Specimens from the northern part of the range are lighter colored and bear a considerable superficial resemblance to *cerastes*, but the head proportions are quite different, being especially narrow in *enyo* and wide in the sidewinder.

The ventral surface is cream, heavily dotted with gray or brown. The edges of the ventral scales are marked by the termini of the secondary body blotches.

The anterior rattle is black.

Material.—The description contained herein is based on an examination of the following specimens, all of which are from the Peninsula of Lower California, except LMK 3002-3 which are from islands in the Gulf of California:

CAS 45879, Miraflores
CAS 45880, San Antonio
CAS 45881, Todos Santos
CAS 45882, San Bartolo
CAS 45883-4, San Pedro
CAS 45885, San José del Cabo
CAS 45886, Sierra Laguna Mts.
LMK 2223-30, La Rivera
LMK 3002, San Francisco Island
LMK 3003, Carmen Island
MVZ 11919-20, Todos Santos
MVZ 11921, Miraflores
MVZ 11922, Eureka
SDSNH 15509, Jaraguay
SDSNH 15510, 10 mi. N. of Cataviña
Stanford 4328, San José del Cabo
USNM 5291, Cape San Lucas (Cotypes, 2 specs.)
USNM 12623, La Paz
USNM 23724, San Pedro Mts.
USNM 37570, Santa Anita

Total preserved specimens 30, of which 8 were seen alive.

Localities, Range.—The localities in which this species has been collected are the following:

Cape Region, Lower California, Mexico
- Cape San Lucas (Type locality)
- La Paz
- San José del Cabo
- San Bartolo
- Miraflores
- Santa Anita
- San Antonio

San Pedro
Todos Santos
Sierra de la Laguna
La Rivera
Eureka
San Pedro Mts.

Central Lower California:
Mulegé

Northern Lower California:
Jaraguay
10 mi. N. of Cataviña

Gulf of California Islands:
San Francisco Island
Carmen Island

Specimens have been seen from all of these localities except Mulegé.

Thus, it will be observed that the species ranges northward throughout Lower California from the Cape almost to the southern end of the San Pedro Martír Mountains. (See Map). The two San Diego Society of Natural History specimens are of particular interest, for these (collected late in 1930 by L. M. Huey at Jaraguay and near Cataviña) carried the species 270 miles to the north of the previous record (Mulegé). And these northern specimens, taken within 50 miles of the known range of *C. c. oreganus*, instead of indicating a tendency toward intergradation with the latter, are even more distinctive in coloration than the Cape specimens, and are quite as different in lepidosis and form.

The only species of rattlesnakes now known to have ranges coincident with *enyo* are *mitchellii* throughout the entire range, *lucasensis* in the Cape region, and *ruber* in central and northern Lower California.

Habits.—Not much is known concerning the habits of this species. From observations of captive specimens and the character of the eye one would judge it to be largely nocturnal. It does not seem to be vicious.

A specimen 608 mm. in length collected March 22, contained eggs.

It is known to feed on mammals. Both island specimens contained mammal remains.

These snakes in their movements progress as do ordinary rattlers and not like sidewinders, this statement being based on field observations by L. M. Huey and captive specimens seen by the writer. Nevertheless it is believed that the superficial color resemblance (particularly of the northern specimens) to *C. cerastes* has led to some confusion, and it is my opinion that *enyo* is the basis of the widespread supposition that the sidewinder occurs in north-central Lower California.[7] While the presence of *cerastes* here is by no means impossible, definitely identified specimens are lacking, the most southerly of which I have knowledge being from the San Felipe Desert somewhat south of Lat. 31 deg.

The venom yield is moderate for a snake of this size, 0.2666 g. of dried

[7] North, A. W., 1910. Camp and Camino in Lower California, p. 145.

purified venom being secured from five large and three medium specimens. From this an adult yield of about 0.04 g. might be expected. Githens and George report the M. L. D. for 350 g. pigeons as 0.1 mg., equal to *oreganus* and somewhat more powerful than *atrox* venom. *Enyo* venom being 40 per cent as toxic as *tigris,* and in four times the quantity, it is probably a more dangerous snake than *tigris.*

Diagnostic Characters.—Enyo is characterized, especially as to form, by its slender head, and, as to color and pattern, by the brightness of the hues and the distinctness of the marks. Pattern alone will distinguish this form from all other species except *confluentus* and its subspecies; especially is the pattern different from *polystictus,* which appears to be the only other member of the genus having so long and slender a head.

Superficially *enyo* most nearly resembles *cerastes* and *stephensi.* From the former it may be readily segregated by the lack of horns; although the supraoculars are distinctly raised, they are not the true horn-like appendages of *cerastes.* Some specimens of *stephensi,* particularly from the northern part of its range, are not unlike *enyo* in color and pattern. Here we must depend for identification on the supraocular sutures, which are almost invariable in *stephensi,* but absent in *enyo,* and the head shape, the former having a relatively larger, and especially broader, head.

DIFFERENTIAL CHARACTERISTICS

The table herewith has been prepared for the purpose of indicating the essential differences of *tigris* and *enyo* from each other and from those species and subspecies to which they appear to be most nearly allied, or with which they have been confused. Thus there are presented schedules of the two species under consideration and, in addition, *Crotalus confluentus stephensi* with which *tigris* was formerly grouped; *Crotalus confluentus mitchellii* which has been considered by some to be closely allied to *tigris; Crotalus confluentus oreganus* which has been referred to by certain authors as in possible subspecific relationship with *enyo;* and *Crotalus cerastes* which has some superficial resemblances to both, but especially *enyo.*

The *mitchellii* material has been divided into two parts, namely, that from Arizona and from Lower California, the many available California specimens being excluded from the tabulation. It was thought that if there were any tendency in *mitchellii* toward *tigris* or *enyo,* this would best be shown by treating separately the adjacent geographical groups of specimens.

Similarly, in the case of *oreganus,* the comparative material is restricted to the nearest available specimens to the *enyo* territory, that is, specimens from Lower California and San Diego County, California;

oreganus as a whole covers a very large area and some minor variations are found throughout the range.

In the following notes on the differential characteristics the discussion is limited to those which show tendencies of interest, not all of those listed in Table No. 1 being mentioned.

Scale Rows

The scale rows of *tigris* are normally 23 and of *enyo* 25. The *confluentus* subspecies usually have 25, although there is a tendency in *mitchellii-stephensi* toward 23 in the northern and eastern areas of their ranges. Thus eight out of seventeen Arizona *mitchellii* have 23 rows, while the same is true of only one out of nineteen from Lower California. *Cerastes* is definitely lower than the other species.

Ventrals and Caudals

Both *tigris* and *enyo* have lower average ventral scale counts than the *confluentus* subspecies, all of which are approximately the same. In this characteristic neither *stephensi* nor Arizona *mitchellii* is conspicuously lower than Lower California *mitchellii* or *oreganus*. Thus in ventral scales there is a fairly definite differentiation between *stephensi* and *tigris,* there being some overlapping in extremes, but none in what might be considered the normal range. *Cerastes* is below all others to such an extent that there is no overlapping.

There is no noteworthy difference in the caudal counts amongst these several species, except in the case of *cerastes* which is below all others.

Labials

In number of labials *enyo* and *tigris* are again intermediate between *cerastes* and the *confluentus* subspecies, *stephensi* being the lowest of the latter.

None of these species or geographical groups has more than an occasional divided first infralabial or intergenial with the exception of the Arizona *mitchellii,* which has no less than half the first infralabials divided, and a fourth further cut to form intergenials. Thus, in this species, we find a tendency toward those characteristics which distinguish *ruber* and *exsul* in the *atrox* group.

Miscellaneous Head Scales

The rostral-prenasal contact, as usual, brings *mitchellii,* from whatever area, into sharp contrast with the remaining species under discussion,

Species—	*Tigris*	*Enyo*	*Stephensi*	*Mitchellii*	*Mitchellii*	*Oreganus*	*Cerastes*
Number of specimens tabulated	25	30	39	19	17	100	109
Area from which specimens have come.	Ariz., Son.	Lower Cal.	Cal., Nev.	Lower Cal.[6]	Ariz.	L.Cal., S.D.Co.[13]	Cal., Ariz., L. Cal.
Scale rows, extremes	22—25	23—27	23—25	23—27	23—27	23—27	19—25
" " normal	23	25	23—25	25	23—25	25	21—23
" " average	23.3	25.2	23.5	25.1	24.1	25.0	22.3
Ventrals, males, extremes	161—172	160—167	166—181	172—181	169—180	167—181	134—150
" males, normal	164—169	162—167	170—180	173—181	.....	170—177	137—146
" males, average	166	164	175	177	174	173	142
" females, extremes	165—173	165—177	173—182	177—187	163[9]—180	172—184	137—153
" females, normal	.....	169—173	173—182	.....	.....	176—180	142—148
" females, average	168	170	178	180	175	177	146
Caudals, males, extremes	23—26	22—28	23—27	23—27	21—28	20—28	19—27
" males, normal	24—25	23—27	23—26	.....	.....	22—26	20—23
" males, average	24.7	25.1	24.8	24.2	24.2	24.0	21.2
" females, extremes	20	18—22	17—22	20—23	17—22	17—23	12—20
" females, normal	.....	18—20	18—22	.....	.....	19—21	15—18
" females, average	20.0	19.3	19.5	21.8	19.6	20.0	17.1
Supralabials, extremes	11—15	12—15	12—16	14—19	14—19	13—17	11—14
" normal	12—14	13—14	13—15	15—17	15—17	14—16	12—14
" average	13.4	13.4	14.3	16.1	15.2	14.8	12.6
Infralabials, extremes	11—16	12—15	13—18	13—18	14—18	13 19	11—16
" normal	13—15	13—14	14—16	15—17	14—17	15—17	12—14
" average	13.8	13.6	14.9	15.9	16.0	15.7	13.1
Per cent divided first infralabials	6.8	0.0	0.0	5.9	50.0	0.0	0.0
Per cent intergenials	0.0	0.0	0.0	4.2	25.0	1.4	0.0
Rostral–prenasal contact (per cent positive)	100.0	100.0	100.0[5]	6.1	9.7	100.0	100.0
Internasals, extremes	2	2	2—4	.....[7]	.....[7]	1—6	2—3
" normal	2	2	2	.....	.....	3—4	2
" average	2	2	2.1	.....	.....	3.7	2.02
Canthals, extremes	2—4	1—3	2—4	3—7	4—6	1—4	1—3
" normal	2—3	2	2—4	4—6	4—6	2—3	2
" average	2.5	2.3	3.1	4.8	4.9	2.3	2.1
Scales before supraoculars, extremes	11—25	13—25	13—38	30—40[10]	22—40[10]	14—40	12—34
" " average	15.6	16.5	24.8	34.9[10]	32.6[10]	24.6	20.4
Scale rows between supraoculars, extremes	3—6	2—6	3—8	4—8	2—7	1—9	2—6
" " " " average	4.8	4.2	5.4	5.4	5.1	4.7	4.2
Per cent of sutured supraoculars	0.0[1]	0.0	96.9	16.7	12.5	10.0	....
Prenasal–supralabial contact (per cent of each type)							
Prenasal in contact with supralabials	97.8	87.5	84.9	7.2	22.6	75.4	99.2
Partial contact	2.2	8.9	3.0	35.7	48.4	10.1	0.8
No contact	0.0	3.6	12.1	57.1	29.0	14.5	0.0
Nasals	2	2	2	2	2	2	2
Loreals, extremes	1—2	1—4[4]	1—5	1—2[8]	1—2[8]	1—2	1
" normal	1	2	1—3	1—2	1—2	1	1
" average	1.1	2.1	1.8	1.7	1.5	1.2	1.0
Postnasal–preocular contact (per cent of each type)							
Upper preocular in contact with postnasal	6.5	5.4	0.0	0.0	0.0	53.3	0.0
Contact prevented by upper loreal	10.9	87.5	55.0	82.4[8]	58.3[8]	14.4	0.0
Contact prevented by canthal–lower-loreal contact	76.1	7.1	45.0	17.6	41.7	31.7	100.0
Indeterminate (borderline)	6.5	0.0	0.0	0.0	0.0	0.6	0.0
Divided upper preoculars, per cent	0.0	0.0	19.0	50.0	93.7	0.0	0.8
Preoculars, extremes	2—3	2—3	1—3	2—4	2—3	2—3	2—3
" average	2.1	2.0	2.0	2.2	2.4	2.0	2.1
Total scales in orbit, extremes	7—10	8—13	7—10	8—10	8—11	8—10	7—10
" " " " normal	9	9—10	8—10	9	8—10	8—10	8—9
" " " " average	9.0	9.7	8.9	9.0	9.0	9.0	8.6
Minimum scales, labials to orbit, extremes	1—2	2—3	2—3	3	2—4	2—4	2—3
" " " " average	1.6	2.1	2.2	3.0	3.0	2.5	2.1
Unkeeled scale rows, sides	2	1	1	1	1	2	2
Ratio, total length to head length, extremes	23.9—28.8	22.5—25.8	20.2—24.0	20.5—27.6	20.3—24.1	19.7—23.2	17.5—23.8
" " " " " " average	26.1	23.8	22.2	24.5	22.1	21.6	19.9
Ratio, across supraoculars to space between, extremes	2.3—3.4[2]	2.9—4.7	2.3—3.3	1.9—2.7	2.4—2.8	2.0—3.5	.
" " " " " " average	2.6	3.5	2.8	2.5	2.6	2.6	
Postnasal–preocular contact (per cent of each type)							
Higher than wide	0.0	0.0	0.0	0.0	6.7	100.0	0.0
Equal	0.0	0.0	7.4	6.7	13.3	0.0	0.0
Wider than high	100.0	100.0	92.6	93.3	80.0	0.0	100.0
Ratio, tail length to total length, males, extremes	.077—.092	.084—.098	.071—.089	.063—.084	.069—.088	.064—.087	.077—.099
" " " " " " males, average	.081	.091	.081	.076	.077	.076	.088
" " " " " " females, extremes	.065—.069	.061—.072	.053—.066	.059—.068	.056—.064	.052—.069	.051—.071
" " " " " " females, average	.067	.065	.061	.064	.060	.060	.062
Ratio, head length to head width, average	1.38	1.52	1.29	1.24	1.21	1.27	1.17
Postocular stripe, extreme width	2—3	3—5	2—3	Obs.	Obs.	2—3	Obs.
" " average width	2+[3]	3.5	2.2[3]	"	"	2+	"
" " per cent intersecting mouth	0.0	0.0	0.0	.....	.....	0.0	
" " per cent above mouth	100.0	100.0	100.0	.....	.....	100.0	....
Supraocular cross-dash absent, per cent	20.0	0.0	53.0	50.0	40.0	4.5	0.0
" " present, per cent	80.0	100.0	47.0	50.0	60.0	95.5	100.0
Body blotches, extremes	40—51	30—42	30—43	28—38	29—37	29—43	30—44
" " average	43.9	33.5	37.1	32.8	33.8	35.2	36.6
Tail rings, males, extremes	7—10	5—8	6—8	3—6	5—9	3—6[12]	3—6
" " males, average	8.3	6.2	6.7	4.3	6.9	4.3	4.4
" " females, extremes	5—7	4—5	3—6	3—4	4—6	3—4	3—5
" " females, average	6.7	4.3	4.7	3.4	5.1	3.4	3.6
Black tail rings, males, per cent	0.0	0.0	26.0	57.0	45.0	Ex. young	66.0
" " females, per cent	0.0	0.0	44.0	100.0	56.0	"	53.0
Color anterior rattle, per cent light	90.0	17.0	3.0	12.5	13.3	Light in	0.0
" " per cent ½ light	5.0	13.0	0.0	50.0	13.3	young. Black	0.0
" " per cent dark	5.0	70.0	97.0	37.5	73.4	in adults	100.0
Venom M.L.D.[13]	0.04	0.10	0.20	0.40	0.40	0.10	0.12

[1] There is one specimen out of 25 with possible supraocular sutures, although these are more probably creases resulting from improper preservation.
[2] The maximum is from a single unusual specimen; except for this the maximum is 2.8.
[3] Usually practically obsolete.
[4] There is a peculiar scale usually present below the first canthal, between the supraocular and the upper loreal, which might be interpreted as a third loreal.
[5] Many have parts of the prenasals cut off, the beginning of the characteristic *mitchellii* separation.
[6] Includes no island specimens.
[7] This is never a definite quantity in *mitchellii*.
[8] Loreals in *mitchellii* are not definite.
[9] A single unusual specimen 12 below any other.
[10] This figure is without great accuracy in *mitchellii* because of the breaking up of the scales.
[11] Eleven specimens from Lower California, the remainder from San Diego Co., Calif.
[12] Not particularly accurate owing to the tendency of the final yellow ring in the young to split into several black rings (2 or more) with increased age.
[13] The M.L.D. is taken from the results of Githens and George and is in terms of mg. for 350 g. pigeons.

for *mitchellii* rarely has these scales in contact, while the others have contact invariably. However, this is not the case with *oreganus* from all areas; Arizona *oreganus,* particularly those from the northern part of the range, have the prenasals sutured in many cases, and in about 15 per cent of the specimens contact is entirely prevented.

Internasals are normally two in all of these forms except in *mitchellii,* which is indeterminate, and in *oreganus* which has normally 3 or more. This is a character which will seldom fail to separate *enyo* from *oreganus.*

Enyo and *tigris,* with their simplified scale arrangements, usually have fewer scales on the crown anterior to the supraoculars than any of the other forms. However in this character they do not approach *scutulatus* or *molossus.* In minimum scale rows between supraoculars there is no important difference between the species under consideration.

Sutured supraoculars, almost always present in *stephensi* and absent in *tigris,* constitute an excellent key character for segregating these two forms. This will also separate *stephensi* from *enyo.*

The prenasal-supralabial contact is not of importance in distingushing the forms here under consideration, since contact is normal in all except *mitchellii.*

The loreals are quite variable in the *confluentus* subspecies and are not a definite quantity in *mitchellii.* It is worthy of note, however, that *tigris* rarely has more than one or *enyo* other than two. *Enyo* usually has an extra scale, not found in the other species (except some *mitchellii*), between the upper loreal and the point of the supraocular.

Neither the postnasal-preocular contact, nor the ocular arrangements show useful differences between these species.

The rostral shape is of interest, particularly in distinguishing *enyo* from *oreganus,* for in the former it is always wider than high and in the latter the opposite. *Tigris* and *cerastes* are like *enyo; mitchellii* and *stephensi* usually, but not invariably so.

Form

The relative head size is of distinct importance in the differentiation of the two species under consideration. *Tigris* has proportionately the smallest head of any of the western rattlesnakes, this being one of the most evident differences from *stephensi,* and in fact from all of the *confluentus* subspecies. Only *mitchellii* from Lower California has a distinctly smaller head than the others, being shorter even than *enyo,* which in turn is shorter than the rest. It must be remembered, in checking this character-

istic, that only adults can be considered, as the young have proportionately larger heads. In addition, some variations are to be expected owing to distortion in preservation; as many as possible should be measured prior to setting.

Enyo has a conspicuously narrow head, followed by *tigris.* The *confluentus* subspecies do not differ much from each other except that *mitchellii* is somewhat the broadest. All are proportionately wider than *tigris* and *enyo. Cerastes* in turn is broadest of all.

The ratio of the distance across to the space between the supraoculars is definitely high in *enyo* owing, of course, to the narrow head. The others do not differ in important degree.

The tail-length ratios seem to show no important differences; *enyo* seems to have a slightly longer tail, followed by *cerastes.*

Pattern

Tigris has a definitely higher number of crossbands than the other species under consideration, which do not differ greatly from each other. In the importance of punctations in the character of markings, *tigris* most nearly resembles *mitchellii,* particularly the Lower California specimens of the latter, rather than *stephensi. Enyo,* in its sharp and definite color contrasts, most nearly resembles the northern specimens of *stephensi* and, in color, *cerastes.*

Venom

The recent results of Githens and George tend to validate the segregation of *tigris* from *stephensi,* in that the venom of the former is found to be five times as toxic as the latter. No difference is found between *enyo* and *oreganus* venom. It is of interest to note a wide separation between *tigris* and *mitchellii.*

Conclusions

Crotalus enyo of Lower California, and *Crotalus tigris* of the mountains of southern Arizona and Sonora are valid and distinct species. Superficially, particularly in color and pattern, *tigris* resembles *Crotalus confluentus mitchellii* and *C. c. stephensi,* but from these it differs in important structural features, especially relative head dimensions, and in venom. In bodily proportions it more nearly resembles *enyo* than it does the *confluentus* subspecies.

Enyo, in color and pattern, most nearly resembles *stephensi,* particularly specimens from the northern areas of the latter, and in color, *cerastes.*